

Our File No. 9281-4763
Client Reference No. FC US02073

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
APPLICATION FOR UNITED STATES LETTERS PATENT

INVENTOR: Yukiharu Hayashi

TITLE: Rotary Push Switch Device

ATTORNEY: Gustavo Siller, Jr.
BRINKS HOFER GILSON & LIONE
P.O. BOX 10395
CHICAGO, ILLINOIS 60610
(312) 321-4200

EXPRESS MAIL NO. EV 327 136 257 US

DATE OF MAILING 2/6/04

ROTARY PUSH SWITCH DEVICE

BACKGROUND OF THE INVENTION

1. Field of the Invention

5 The present invention relates to a rotary push switch device that is preferably applied to an input to an air conditioner, a navigator, and the like, which are mounted on a vehicle, and is most suitable when a design is formed at a center.

10 2. Description of the Related Art

There are many switch devices that employ known technologies and can be subjected to rotary and push operations. For example, various types of electric parts such as rotary switches, push button switches, and the like, 15 which are used in audio systems, air conditioners, and the like, are mounted on vehicles, and these electric parts are operated by drivers and passengers who manually manipulate operation knobs. Among these vehicle-mounted electric parts, there is known a rotary push switch device used in, for 20 example, an audio system. The rotary push switch device has a rotary switch, which adjusts a sound volume of the audio system, and a push button switch, which is disposed in the rotary switch and turns on and off a power supply to the audio system as well as has a rotary knob for operating the 25 rotary switch and a push knob for operating the push button switch, and these knobs are disposed coaxially with each other. Further, there is also known a rotary push switch device applied to a digital camera with a zoom function as

disclosed in, for example, Japanese Unexamined Patent Application Publication No. 2001-357758 (refer to paragraph Nos. 0011 to 0029 and FIGS. 2 and 3 of the specification), which will be shown in FIGS. 4 and 5.

5 The rotary push switch device shown in FIGS. 4 and 5 is a device applied to a digital camera with a zoom function. The switch device is mainly composed of a support plate 1 made of a metal plate and the like, a flexible substrate 2, which is made of an insulating base member such as a 10 polyester film and the like and has electric conductive patterns formed thereon, a first dome-shaped click spring 3 that also acts as a first movable contact element, a synthetic resin guide member 4 having a plurality of guide projections 4a, a synthetic resin drive member 5, which has a 15 push projection 5a and can be caused to rise and fall by being guided by the guide projections 4a, a second dome-shaped click spring 6 that also acts as a second movable contact element, a metal slider element 7, a synthetic resin slider element receiver 8 to which the slider element 7 is 20 attached, a synthetic resin accommodation member 9 having a ceiling portion 10 and a cylindrical portion 11, a self-return torsion spring 12, a synthetic resin key top 13, and a synthetic resin rotary operation member 14 arranged integrally with the slider element receiver 8.

25 The flexible substrate 2 is assembled in the rotary push switch device with its band-shaped portion 2c bent in an S-shape.

 The first dome-shaped click spring 3, which also acts as

the first movable contact element, is formed of a stainless steel sheet spring and formed in a dome shape. The click spring 3 is placed on the region of the flexible substrate 2, in which a first stationary contact element (not shown) is 5 formed, comes into contact with an outer ring-shaped portion of the stationary contact element at all times as well as confronts an inner disc-shaped portion of the stationary contact element so as to come into contact with and depart from the portion. A first push switch element S1 is composed 10 of the first click spring 3 and the first stationary contact element. When a somewhat large press operation force is applied to the click spring 3, the inverted central portion of the click spring 3 is caused to come into contact with the disc-shaped portion of the stationary contact element that 15 confronts the central portion, so that the inner stationary contact element is electrically connected to the outer stationary contact element.

Since the second dome-shaped click spring 6, which also acts as the second movable contact element, is made of a 20 stainless steel spring sheet and formed in a dome shape, the central portion of the click spring 6 can be inverted by a press operation force smaller than that of the first click spring 3. The second click spring 6 is placed on the region of a band-shaped portion 2c of the flexible substrate 2, in 25 which a second stationary contact element (not shown) is formed, comes into contact with an outer ring-shaped portion of the stationary contact element at all times and confronts an inner disc-shaped portion of the stationary contact

element so as to come into contact with and depart from the portion. A second push switch element S2 is composed of the second click spring 6 and the second stationary contact element. When a relatively small press operation force is 5 applied to the click spring 6, the inverted central portion of the click spring 6 is caused to come into contact with the inner disc-shaped portion of the stationary contact element confronting it, so that the inner stationary contact element is electrically connected to the outer stationary contact 10 element.

The guide member 4 has four elastically deformable columnar guide projections 4a, a frame-shaped portion 4b for coupling the base ends of the respective guide projections 4a, and three attachment projections 4c which extend from the 15 frame-shaped portion 4b in a direction opposite to the guide projections 4a. Each guide projection 4a has a claw portion 4d projecting inward at the extreme end (free end) thereof. Further, the frame-shaped portion 4b has an engagement groove 4e that is formed thereto by projecting a part of the frame- 20 shaped portion 4b outward in an L-shape.

The drive member 5 includes a push projection 5a for pushing the first click spring 3, a flat sheet portion 5b projecting the push projection 5a from the center thereof, engagement cutouts 5c, which are formed at four positions on 25 the outer peripheral portion of the flat sheet portion 5b and into which the guide projections 4a are loosely inserted, respectively, an L-shaped hook 5d projecting sideward from flat sheet portion 5b, and a small projection 5e projecting

from the flat sheet portion 5b sideward on a side opposite to the hook 5d.

The accommodation member 9 includes the ceiling portion 10, which has an opening 10a at the center thereof and arc-shaped slots 10b disposed at four positions, a cylindrical portion 11 suspending downward from the outer peripheral portion of the ceiling portion 10, and attachment projections 11a projecting at equal intervals from the bottom surface of the cylindrical portion 11 at six positions. Further, a ring-shaped wall 10d, which regulates the position of the self return torsion spring 12 from an inside, and a spring receiving portion 10f, which causes a taper surface 10e to collide against an end of the torsion spring 12 and to stop thereat, stand on the ceiling portion 10, and the torsion spring 12 is assembled between the ring-shaped wall 10d and the spring receiving portion 10f.

The drive member 5, on which the second push switch element S2 is placed, and the guide projections 4a of the guide member 4 are disposed in the opening 10a of the accommodation member 9. Further, the slider element receiver 8 is disposed inwardly of the cylindrical portion 11 of the accommodation member 9 in confrontation with the ceiling portion 10, and the outer peripheral surface of the slider element receiver 8 is in sliding contact with the inner peripheral surface of the cylindrical portion 11. Then, the rotary operation member 14 is integrated with the slider element receiver 8 by inserting four coupling projections 14b of the rotary operation member 14, which is disposed on the

ceiling portion 10 of the accommodation member 9, into the slots 10b, respectively and further into coupling holes 8b of the slider element receiver 8, and thermally caulking the extreme ends of the respective coupling projections 14b to 5 the bottom surface of the slider element receiver 8.

Accordingly, the rotational motion of the rotary operation member 14 is guided by the inner peripheral surface of the cylindrical portion 11 that functions as a bearing surface with respect to the outer peripheral surface of the slider 10 element receiver 8.

The rotary operation member 14 has an opening 14a, in which the key top 13 is disposed, at the center thereof. The coupling projections 14b project from the bottom surface of the rotary operation member 14 at four positions at equal 15 intervals, and the rotary operation member 14 is integrated with the slider element receiver 8 through the coupling projections 14b. Note that a push projection 13a, which projects from the center of the inner bottom surface of the key top 13, is mounted on the second click spring 6 in a 20 state that the rotation of the key top 13 is prevented by the rotary operation member 14, and the rising and falling motion of the key top 13 is guided by the inner wall portion of the rotary actuating member 14.

An operation of the rotary push switch device arranged 25 as described above will be explained. First, an operation of a push switch portion, which is pressed through the key top 13, will be explained. Next, an operation of a rotary type electric part portion, which is rotated through the rotary

operation member 14, will be explained.

When an operator pushes the key top 13 with a finger in a predetermined amount, the push projection 13a of the key top 13 inverts the second click spring 6 having a small operation force, thereby the second push switch element S2 is switched from an on-state to an off-state. When the operator further pushes the key top 13, the drive member 5 is caused to fall while the on-state of the second push switch element S2 is kept, thereby the push projection 5a of the drive member 5 inverts the first click spring 3 having a large operation force, so that the first push switch element S1 is switched from an off-state to an on-state. Accordingly, when a click feel is imparted at the time the operator lightly pushes the key top 13, the operator can feel that the second push switch element S2 has been turned on, and when a click feel is imparted at the time the operator strongly pushes the key top 13, the operator can feel that the first push switch element S1 has been turned on. Specifically, in the embodiment, when the second push switch element S2 is turned on, a digital camera is focused, and when the first push switch element S1 is turned on, a shutter is actuated.

Further, when the rotary operation member 14 is rotated by the operator, the slider 7 is rotated together with it and slides on the sliding patterns (a resistor pattern and a collector pattern) formed on the flexible substrate 2, thereby a resistance value is output according to a position of the rotatingly moved slider 7. That is, a different resistance value can be output according to an amount of

rotation of the rotary operation member 14, and in this embodiment, zooming of the digital camera can be executed by rotating the rotary operation member 14.

Incidentally, in a known rotary push switch device, a 5 center knob on which a center logo is formed, is arranged so as not to be rotated. Accordingly, since a knob (key top 13) located at a center has only a push function and a rotary function is provided with only an outside knob (rotary operation member 14), when a push operation is executed 10 continuously from a rotary operation, it is difficult to execute the push operation by means of the outside knob, and thus the known rotary push switch device is disadvantageous in operability.

Accordingly, an object of the present invention, which 15 was made in view of the above circumstances of the related art, is to provide a rotary push switch device arranged such that when a push operation is executed through a push knob, the push operation is executed by a rotary push knob in association with the push operation of the push knob.

20

SUMMARY OF THE INVENTION

To achieve the above object, a rotary push switch device of the present invention includes a cylindrical rotary push knob that is subjected to push and rotary operations, a 25 rotary type electric part unit rotated by the rotary push knob, a push knob that is subjected to a push operation, and a push switch unit pressed by pushing the push knob, wherein when the rotary push knob is subjected to the push operation,

the push knob is pushed in association with the rotary push knob, and when the rotary push knob is subjected to the rotary operation, the push knob is prevented from being rotated in association with the rotary push knob.

5 With the above arrangement, when the rotary operation is executed, the push knob, on which a center logo is formed, is not rotated and only the rotary push knob disposed outwardly of the push knob is rotated, and when the push operation is executed, the push knob and the rotary push knob can be
10 pushed together at the same time.

In the above arrangement, it is preferable that the push knob be disposed inwardly of the rotary push knob.

Further, in the above arrangement, it is preferable that the rotary type electric part unit includes a rotary cam that
15 is coupled with the rotary push knob and operated together with it, the rotary push knob include a projection, the push knob be clamped between the projection and the rotary cam, when the rotary push knob or the push knob is subjected to the push operation, the rotary push knob and the push knob be
20 operated at the same time, and when the rotary push knob is subjected to the rotary operation, the rotary push knob be free to move with respect to the push knob.

In the above arrangement, it is preferable that the projection of the rotary push knob be formed in a ring shape.

25 Further, in the above arrangement, it is preferable that the push switching unit include a holder that holds a substrate on which a stationary contact element is disposed and that the push knob be fixed to the holder through a hook.

Further, in the above arrangement, it is preferable that the substrate include a light source that illuminates the push knob.

5 BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a longitudinal sectional view of a rotary push switch device according to an embodiment of the present invention;

FIG. 2 is a longitudinal sectional view of the rotary push switch device shown in FIG. 1 when it is subjected to a push operation;

FIG. 3 is an exploded perspective view of the rotary push switch device shown in FIG. 1;

FIG. 4 is a longitudinal sectional view of a known rotary push switch device; and

FIG. 5 is a sectional view of the known rotary push switch device taken along a diagonal line when it is viewed on plane.

20 DESCRIPTION OF THE PREFERRED EMBODIMENTS

An embodiment of the present invention will be explained with reference to the drawings. FIG. 1 is a longitudinal sectional view of a rotary push switch device according to the embodiment of the present invention, FIG. 2 is a longitudinal sectional view of the rotary push switch device shown in FIG. 1 when it is subjected to a push operation, and FIG. 3 is an exploded perspective view of the rotary push switch device shown in FIG. 1.

As shown in the drawings, the rotary push switch device according to the embodiment is composed of a push knob 20, a rotary push knob 21, a push ring 22, a push rubber contact element 23 that is pushed by the push ring 22, a push 5 substrate 24, which is paired with the push rubber contact element 23 and constitutes a push switch, a hard ball holder 27 for holding hard balls 25 and springs 26, which impart a click feel when a rotary operation is executed, a rotary cam 28, a rotary drive plate 29 for detecting the rotary 10 operation, a sensor substrate 30, which is paired with the rotary drive plate 29 and detects the rotary operation, a shaft 31, a support plate 32, a main substrate 33, and upper and lower cases 34 and 35 that support the support plate 32 and the main substrate 33. The rotary push knob 21 has an 15 opening 21a in which the push knob 20 is disposed and executes also a push operation, the push ring 22 is pushed by the push knob 20 and transmits the push operation to a contact element, the rotary cam 28 is operated in association with the rotary push knob 21 and has a cam 28c for imparting 20 a click feel by being paired with the hard balls 25, the shaft 31 holds the hard ball holder 27, the drive plate 29, and the sensor substrate 30, the support plate 32 supports all the hard ball holder 27, the rotary drive plate 29, the 25 sensor substrate 30, and the shaft 31, and the main substrate 33 brings together the signals output by the rotary operation and the push operation.

The push knob 20 is made of synthetic resin and formed in a cylindrical shape having an open lower surface and a

closed upper surface. The push knob 20 is disposed in an opening 21a of the rotary push knob 21. The push knob 20 has a ring-shaped engaging portion 20a formed in a recessed groove shape at the upper end of the outer peripheral surface 5 thereof, and the rotary push knob 21 is engaged with the ring-shaped engaging portion 20a. Further, the push knob 20 has engaging portions 20b formed at four positions and integrated with the hard ball holder 27 by being hook coupled with projections 27g disposed to the hard ball holder 27 10 through the engaging portions 20b.

The push ring 22 is subjected to a push operation executed by the push knob 20 and transmits it to the push rubber contact element 23. As shown in FIG. 3, the push ring 22 is composed of a ring portion 22a, four projections 22b 15 projecting from the outer peripheral surface of the ring portion 22a, and four contact element push pieces 22c extending from the inner peripheral surface of the ring portion 22a toward a center.

The push rubber contact element 23 is formed of four 20 push rubber contact sub-elements 23, which are molded together, and attached to the push substrate 24, which is paired with the push rubber contact element 23 and constitutes a push switch, so as to cover the push substrate 24.

25 The push substrate 24 includes an illumination LED 24a that can illuminate the push knob 20. The push substrate 24 is formed in a square shape and has fixed contact portions formed thereto (not shown) so as to be connected to the

respective push rubber contact sub-elements 23. Further, although not shown, the push substrate 24 has positioning/fixing holes drilled therethrough, and the push substrate 24 is fixed on the upper surface of the hard ball holder 27 by 5 fitting positioning/fixing projections projecting from the hard ball holder 27 into the holes.

As shown in FIG. 3, the hard ball holder 27 is formed in a cylindrical shape with the upper and lower surfaces thereof opened and has an upper cylinder portion 27a to which cutout 10 portions 27b are formed from the upper edge thereof at four positions, and the projections 22b of the push ring 22 are inserted into the cutout portions 27b. With the above arrangement, although the push ring 22 can move along the cutout portions 27b of the hard ball holder 27, it is 15 restricted to move in the peripheral direction of the ring portion 22a thereof. The inside of the upper cylindrical portion 27a is arranged as an accommodating portion for accommodating the push rubber contact element 23 and the push substrate 24. The outer peripheral diameter of the lower 20 portion of the hard ball holder 27 is set smaller than that of the upper portion thereof, and a stepped portion 27c is formed around the boundary between the lower portion and the upper portion as well as two accommodation holes 27d, which accommodate and hold the hard balls 25 and the springs 26, 25 are formed at diametrically opposite positions of the hard ball holder 27, and the respective hard balls 25 are urged outward by the springs 26, respectively. Further, a bearing portion 27e is drilled through the lower portion of the hard

ball holder 27 and communicates with the upper portion thereof, and the hard ball holder 27 is fixed by fitting the bearing portion 27e on the shaft 31. The rotation of the push knob 20, which is integrated with the hard ball holder 27 by the above arrangement, is prevented. Further, four positioning/fixing projections 27f project from the bottom surface of the accommodating portion in the upper cylindrical portion 27a. Projections 27g are formed on the upper cylindrical portion 27a at four positions, and the engaging portions 20b of the push knob 20 are hook coupled with the respective projections 27g.

The rotary push knob 21 is molded of synthetic resin and formed in a hollow shape having the cylindrical opening 21a. A ring-shaped projection 21b is formed around the upper edge 15 of the opening 21a of the rotary push knob 21, and a snap claw 21c is formed downward from the lower end of the opening 21a. The ring-shaped projection 21b is engaged with the ring-shaped engaging portion 20a of the push knob 20, whereas the snap claw 21c is engaged with the lower surface an 20 engaging portion 28a formed on the outside surface of the rotary cam 28 at the upper end thereof. With the above arrangement, the rotary push knob 21 is integrated with the rotary cam 28 by snap locking the snap claw 21c to the engaging portion 28a. In contrast, although the push knob 20 25 is integrated with the rotary push knob 21 in a push direction on the outer peripheral surface thereof by the support portion 28e of the rotary cam 28 and the ring-shaped projection 21b of the rotary push knob 21, the rotary push

knob 21 is clamped so as to be free to move in a rotary direction with respect to the push knob 20. Accordingly, the rotary push knob 21 is moved together with the push knob 20 in the push direction of the push knob 20, and when the 5 rotary push knob 21 is rotated, it is rotated together with the rotary cam 28. However, the push knob 20 is not rotated because the rotation thereof is prevented by the hook coupling of it with the projections 27g of the hard ball holder 27.

10 The rotary cam 28 is formed in a cylindrical shape in its entirety, and the engaging portion 28a, which is engaged with the snap claw 21c, is formed on the outer peripheral surface of the upper cylindrical portion at the upper end thereof, and recessed portions 28b are formed to the engaging portion 28a from the lower end of the outer peripheral surface thereof at four positions. Therefore, the rotary cam 28 is operated in association with the rotary push knob 21 by the snap claw 21c. The cam 28c is disposed on the inner peripheral surface of the upper cylindrical portion and 15 imparts the click feel by being paired with the hard balls 25. Further, a bearing portion 28d is disposed in the lower cylindrical portion of the rotary cam 28 and fitted on the shaft 31, thereby the bearing portion 28d can be moved in the axial direction and the peripheral direction of the shaft 31. 20 Further, the support portion 28e is formed to the rotary cam 28 to integrate the push knob 20 with the rotary push knob 21 in the push direction together with the ring-shaped projection 21b of the rotary push knob 21.

The bearing portion 27e of the hard ball holder 27 is fitted on and fixed to a small diameter portion 31a of the shaft 31, the bearing portion 28d of the rotary cam 28 is loosely fitted on a medium diameter portion 31b of the shaft 31 so as to be free to move in the axial direction and the peripheral direction, and further the drive plate 29 and the sensor substrate 30 are held by the shaft 31. Further, a hollow portion 31c is formed to the shaft 31, and connection lines 36 are wired in the hollow portion 31c and connected to respective connectors 37. An urging coil spring 38 is compressed and interposed between the drive plate 29 and the rotary cam 28. The shaft 31 is fixed to the support plate 32 at the lower end thereof, and the support plate 32 is attached and fixed to the lower case 35.

15 A signal from the push substrate 24 is transmitted to the main substrate 33 by passing the connection lines 36 through the shaft 31. A signal from the sensor substrate 30 is also transmitted to the main substrate 33 through the inside of the shaft 31. Further, a signal is supplied to the 20 illumination LED 24a through the inside of the shaft 31 likewise the push switch.

 The urging coil spring 38 is interposed between the rotary drive plate 29 and the rotary cam 28, the rotary cam 28 is urged upward by the urging coil spring 38 and pushed 25 against the hard ball holder 27 fixed to the shaft 31.

 A cover 39 is attached to the lower surface of the lower case 35.

 An operation of the rotary push switch device arranged

as described above will be explained.

FIG. 1 shows a non-operating state of the rotary push switch device. To explain the arrangement of the respective components that are operated in association with each other, 5 the shaft 31 and the hard ball holder 27 are fixedly disposed, and the components such as the push substrate 24 and the like that are fixed thereto are also fixedly disposed. The rotary push knob 21 is integrated with the rotary cam 28 by the snap claw 21c, and the bearing portion 28d is rotatably supported 10 by the shaft 31. Further, the bearing portion 28d is supported by the shaft 31 so as to be moved in the axial direction (up/down direction in the figure by the push operation) of the shaft 31, and when the rotary push knob 21 and the rotary cam 28 are pushed downward in the figure, the 15 push knob 20 is engaged with the ring-shaped projection 21b of the rotary push knob 21 and also pushed downward together with the rotary push knob 21.

When the operator holds and rotates the rotary push knob 21 in the state shown in FIG. 1, the rotary cam 28 is rotated 20 together with the rotary push knob 21. When the rotary cam 28 is rotated, the click feel is imparted by the hard balls 25 that are pressed against the cam 28c by the springs 26 as well as moderated by the recesses of the cam 28c. The rotary drive plate 29 is rotated by the rotation of the rotary cam 25 28, so that the rotary operation is detected by the sensor substrate 30, thereby pulse signals are output according to a rotating direction and an amount of rotation. Desired equipment can be adjusted based on the output signals. As

described above, when the rotary push knob 21 is subjected to the rotary operation, the push knob 20 is not rotated because the rotation thereof is prevented as described above.

Further, when the operator pushes the push knob 20 or 5 the rotary push knob 21 with a finger, they are moved together downward in the figure. At this time, the rotary cam 28 is also lowered against the urging coil spring 38. Further, when the push knob 20 is lowered, the push ring 22 is lowered through the projections 22b and the push rubber 10 contact sub-elements 23 are pushed by the contact element push pieces 22c, thereby a switch signal is output from the push switch. A power supply of desired equipment can be turned on or off in response to the output signal. FIG. 2 shows a state after the push operation has been executed.

15 Note that a reason why four push sub-switches, which are composed of the push rubber contact sub-elements 23, are pushed by the four contact element push pieces 22c, is to prevent a push operation from being uncertainly executed when the peripheral edge of the push knob 20 is pushed, and the 20 like. In contrast, when the push operation is stopped, the rotary cam 28 is moved upward in the figure by the force accumulated by the urging coil spring 38, and thus the rotary push knob 21 and the push knob 20 are also moved upward and return to the state shown in FIG. 1.

25 With the above arrangement, the rotary push switch device includes the cylindrical rotary push knob 21, which is subjected to the push and rotary operations, the rotary drive plate 29, which is rotated by the rotary push knob 21, the

push knob 20, which is disposed in the rotary push knob 21 and subjected to the push operation, and the push rubber contact element 23 which is pressed by pushing the push knob 20, when the rotary push knob 21 is subjected to the push 5 operation, the push knob 20 is also pushed in association with the rotary push knob 21, and when the rotary push knob 21 is subjected to the rotary operation, the push knob 20 is prevented from being rotated in association with the rotary push knob 21. Accordingly, when the rotary push knob 21 is 10 subjected to the rotary operation, a design (logo and the like) formed on the push knob 20 is prevented from being rotated and thus prevented from being inverted because the push knob 20 is not rotated in association with the rotary push knob 21, thereby the commodity value of the rotary push 15 switch device can be improved. Further, since the rotary push knob 21 can be also subjected to the push operation, the operability of the push operation can be improved because the push operation is not interfered with by the rotary push knob 21.

20 The present invention is executed by the embodiment described above and achieves the following effects.

When the rotary push knob is subjected to the rotary operation, the design (logo and the like) formed on, for example, the push knob is not rotated and thus is not 25 inverted because the push knob is prevented from being rotated in association with the rotary push knob, thereby the commodity value of the rotary push switch device can be improved. Further, since the rotary push knob can be also

subjected to the push operation, the operability of the push operation can be improved because the push operation is not interfered with by the rotary push knob.